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A Comparison of Students' Anxiety Levels While Taking Computer Versus Paper and Pencil Timed Math Tests

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The Edwin P. McCabe Honors Program

Senior Thesis

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M. B. Tolson Black Heritage Center
Langston University
Langston, Oklahoma

"A Comparison of Students' Anxiety
Levels While Taking Computer Versus
Paper and Pencil Timed Math Tests"

Angela S. Jungermann

May 2003

Langston University
Langston, Oklahoma

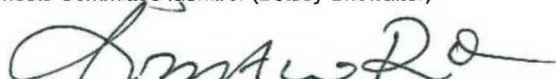
A Comparison of Students' Anxiety Levels While Taking Computer versus Paper and Pencil Timed Math Tests

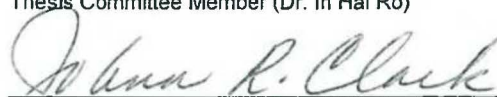
By
Angela S. Jungermann

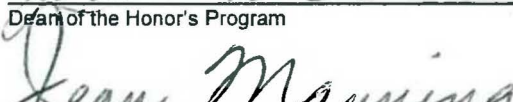
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Abstract

The purpose of this research is to compare and contrast the anxiety levels of students before and after taking the computerized timed math test with the levels before and after taking the paper-and-pencil timed math test. Two second-grade classes were used in this research with each student taking each test once. The computer test, found at www.saxonpublishers.com/activities/basic_fact_sheets/, consisted of 50 addition questions to be completed in 30 seconds, and the paper-and-pencil version, adapted by the researcher from a Saxon created test, consisted of 100 addition questions to be completed in 60 seconds. The students' blood pressures and pulses were taken while they were at rest before the tests, right before they were told to begin the test, and right after the test was over. An elevation from the at rest readings to the beginning readings indicates increase in anxiety, as does an increase from the at rest readings to the ending readings. The differences in blood pressures and pulses of both tests were compared for each student with the least amount of change indicating less anxiety was experienced while taking that test. The scores of the two tests were also compared with the better score indicating less anxiety experienced while taking that test. All the students responded to a survey and several randomly chosen students were interviewed about their experiences and feelings toward the tests and research process.

CHAPTER I

Introduction

“On your mark; get set; go!” These are the words many elementary school students hear, or imagine as they take their daily timed mathematics tests. Timed math tests in the elementary schools are often given to students to help them learn their basic math facts efficiently. The purpose of the timed part of the test is to wean students from using their fingers and other physical methods, so that students will recall answers quickly and accurately in their daily lives. Most, if not all, people use basic math facts in all areas of their lives without thinking about it; such as while grocery shopping, balancing a checkbook, and figuring out how many miles to a gallon of gasoline their cars get. Learning is important, but if students are interested in the subject matter they are learning or the learning process is fun, then the students will be likely to learn more easily and more quickly than if they dislike the subject or find the assignments boring.

The purpose is to compare and contrast the anxiety levels of students before, during, and after taking the paper and pencil timed math test with the levels before, during, and after taking the computerized timed math test. Both the paper and pencil test and the computerized test are available for addition, subtraction, multiplication, division, and a mixture of all four, making the two tests comparable, which allows the researcher to contrast the anxieties that each student experiences during the two tests. Currently the paper and pencil version of the test appears to be the more commonly used test because many elementary school classrooms do not have enough computers to test each student individually. When administering the paper and pencil version of the test, the teacher distributes a copy of the test face down to each child, tells all the students to start, and tells the students when to stop and put down their pencils. The teacher then grades each

test and records the scores. On the other hand, the computerized version of the test begins when the child hits the first key and stops when the child hits enter on the last problem. The test is then scored and the results of how much time was required for the child to complete the test and how many questions were answered correctly in a given period of time are indicated on the computer screen. By grading the tests for the teachers, the computer allows more time for them to plan other activities for their students and gives individual students immediate feedback. The computer program also provides the opportunity for extra practice during the students' free time. While both variations of the tests will improve math skills, such factors as anxiety, self-esteem, and time are also important to consider when teaching.

Background

Timed math tests based on basic math facts in addition, subtraction, multiplication, and division have been administered using paper and pencil in elementary classrooms for many years. Meanwhile, computer technology has been developed, including educational games for elementary age students. There are quite a few math programs available as shareware on the Internet and even more for sale by the computer companies.

Problem and Purpose

The problem for this research is that many students experience anxiety related to timed math tests. The purpose of this research, on the other hand, is to compare and contrast the anxiety levels that students experience when taking the pencil and paper test and the computer test.

Questions and Objectives

The objective of this research is to determine whether there is a difference in the level of anxiety experienced by the students between the two versions of the timed test.

The research questions, therefore, are as follows:

1. Does one test cause less anxiety than the other?
2. Do students prefer one version of the test to the other, which one, and why?

Assumptions

In this research, the following assumptions are made: the students will be in the same grade and school, there are computers available, there will be teachers willing to use the program, and increased heart rate and pulse indicate anxiety.

Definitions

1. Mad Minutes--are a series of timed tests for basic math facts with various numbers of problems to be completed in one minute or less.
2. Timed math test--normally a test with one hundred basic math facts in which the student must complete in a certain amount of time (anywhere from one to five minutes depending on the teacher).

Limitations

The limitations placed on this research are the researcher's limited time frame of one and a half hours in each classroom and the limited number of computers in each of the two classrooms.

CHAPTER II

Review of the Literature

Mathematics began when man counted on his fingers to calculate his trade (Szymanski, Szymanski, and Pulschen, 1995). Computers and mathematics came together when the abacus came into existence with the ancient Egyptians, Romans, Greeks, and Chinese. The abacus was the first machine to do calculations quickly. The revolution in technology since the abacus made today's computers, computer programs, and computer capabilities possible. According to Schwartz (1975), some professionals are now testing school children using computer games; while others are using board games and games found in booklets. Some games used by parents and teachers to help students improve their math skills are *Measure and Move*, *Area-Plane*, *Tic-Toc-Rummy*, *City Blocks*, and *Escribador* (Schwartz, 1975).

Many of the teachers the researcher has contacted currently use a paper and pencil method of improving their students' basic math facts capabilities, and Shermis, Fulkerson, and Banta (1996) claim that paper-and-pencil tests are the most commonly used tests today. One system that teachers use is The Mad Minute created by Paul Joseph Shoecraft and Terry James Clukey (1981). Another system involves a hundred basic math fact problems, has time limits that vary from teacher-to-teacher, and has no specific name and will, therefore, be called the timed math test.

Children need to learn the basic math facts so that they can quickly and easily solve numerical problems that they are likely to encounter on a daily basis throughout their lives. Each day children of all ages are taught mathematics in various forms from counting to measuring area, distance, and time to computing numerical data (Schwartz,

1975). The students learn to represent complex problems by using different methods that include the use of "numbers, symbols, maps, and graphs" (p. 67). Children are coming into contact with computers more and more on a daily basis. This situation brings up questions of convenience, cost, training, and worthiness. Yeloushan (1986) asked,

"Is it worth overcoming the powerful obstacles to bring understanding and knowledge of computers to all elementary teachers? Is it worth asking teachers to redesign their methodology of teaching and curriculum objectives so the computer can be a viable part of their classroom when the methodology and curriculum objectives they are presently using works so well?" (p. 8)

Yeloushan's (1986) answer is,

"The first time a student arrived at school early or gave up his/her recess time to use the computer I knew it was worth it. The last day of school as a student kissed the teacher and the computer good-bye I knew it was worth it." (p. 8)

In addition to helping students, computers can also help teachers develop their own unique teaching styles. Yeloushan (1986) also reports that students are improving their grades on math tests by using computers because there is a reduction in many of the common, careless errors. Yeloushan also believes that once computers are woven into the classroom activities then the possibilities are limitless. Today computers can store grades, average grades, create tests, create assignments, and grade tests and assignments for teachers and students.

Allowing students to learn how to use technology while in the classroom prepares them for their entrance into a technologically advanced society (Herrera and Ozgun-Koca, 1999). Technology also helps children learn important mathematical concepts. Some of the technological tools easily used in classrooms are graphing and scientific calculators, computers, computer software, spreadsheets, databases, and the Internet.

In the researcher's experience in using the Internet and computer programs that were bought and installed on computers, different tests with similar problems can be brought up on the computer and graded quickly after a student solves the questions because computers can sort and perform calculations quickly. Shermis, Fulkerson, and Banta (1996) developed a computerized math placement test to be made available in elementary schools. This program is intended to reflect advanced placement math programs used in middle schools. The test allows parents, teachers, and students to know what the students' ability levels are and if the children should be placed in advanced math classes in the future.

The project began as the traditional paper and pencil test. This test was used to calibrate all the mathematical problems that address objectives found in elementary curriculum. The test was eventually narrowed down to 240 math items. Since students could not be expected to complete such a large paper and pencil exam, the math problems were divided into eight different tests with ten problem types in common for each version of the test. Each test contained around 39 problems in the end. Finally, the paper and pencil test was used to create an efficient computer program for testing the students.

There are several tests in existence that gauge what level of math skill each student possesses. One example is the standardized achievement test which many adults, such as parents and members of school boards, depend on to inform them of how well the students are performing in mathematics (Schwartz, 1975). Most achievement tests contain the three mathematical categories of computation, concepts, and problem solving and are graded by either teacher or computers. Some teachers rely on instruments such as the Mad Minute to learn at what level each student is and how fast he/she is improving on

the basic math facts that also often correlate with the computation of achievement tests (Shoecraft and Clukey, 1981). The Mad Minute program is made up of six levels intended for grades 1-8. The creators of the Mad Minute point out that there are only 390 basic math facts for addition, subtraction, multiplication, and division and that in order to develop instant recall of these basic facts the students need to practice daily. The Mad Minute program encourages students to really learn the basic math facts rather than memorize the order of the answers on the test with the intention that students must answer the problems from left to right and top to bottom instead of answering only the "easy" problems. Shoecraft and Clukey (1981), the creators of the Mad Minute program, also instruct the teachers to count points only up to the first blank problem or incorrect error so that the students will have well-rounded exposure to all the math facts rather than just the "easy" problems. In addition, Shoecraft and Clukey believe that when students have trouble with more complex math problems, it is because they do not know their basic math facts. The Mad Minute also encourages students to compete against themselves rather than against their fellow classmates.

In today's society, computers have become more common in everyday life (Fitch and Sims as cited in Din and Caleo, 2000). Computers have become a part of classrooms, businesses, and homes. Teachers believe that young children can learn more effectively and efficiently if they are provided with more access to computer applications, thus, enhancing their learning capabilities. Children who have regular access to computers are more receptive to learning by using computers than children with little or no access to computers. Additionally, S. W. Haugland's research (as cited in Din and Caleo, 2000) "revealed that children exposed to developmental software had significant

gains in intelligence, structural knowledge, non-verbal skills, complex manual dexterity, and long-term memory” (p. 7). Shute and Miksad (as cited in Din and Caleo, 2000) discovered that Computer Assisted Instruction software was unsuccessful in improving basic math skills. Din and Caleo (2000) also found that having students play Lightspan activities five days a week for eleven weeks only slightly increased math grades. Research reveals that a young child’s “social, psychological, cognitive, and academic development” improves when exposed to computer technology (Din and Caleo, 2000).

Research indicates that people who have experience with computers normally feel less anxiety than people without computer experience when computers are made accessible to them (Lee, Llabre et al., Russon, Josefowitz, Edmonds, and Tardif as cited in Dimock and Cormier, 1991). Computer unfamiliarity is associated with computer anxiety both of which are related to lower computerized test grades (Johnson and White, Lee, Lee, Moreno, and Sympson, Llabre et al. as cited in Dimock and Cormier, 1991). Meanwhile, Cormier and Dimock (1991) performed two experiments that revealed that the scores of the original pencil and paper test were better than the scores on the similar computer format. Rocklin and Thompson (as cited in Wise et al., 1992) found that when faced with a test that was rated difficult, the participants who experienced the least anxiety performed better than most of the high anxiety participants. However, on a test with a relatively low rating of difficulty, the participants with moderate anxiety showed a better performance than most of the other participants.

Johnson and Ross (1989) observed that computers in the classrooms of Lester Demonstration School were used as incentives for students to get their work done efficiently. When the students completed their assignments, they were given permission

to play computer games. Johnson and Ross studied how three teachers used computers in their classrooms to aid teaching. The math teacher separated her class into two different groups. The teacher would have half the class work on the computer with math programs while she actively taught the other half of the class at a table on the other side of the classroom.

The group on the computers worked on a two-digit multiplication program (Johnson and Ross, 1989). The students would use a cartoon character named "Fearless" to open doors finding numbers. After the numbers were discovered, the computer would display them in a basic multiplication problem format. The students would then multiply each digit through solving the partial products. After the children solved the partial products they added the two numbers together to figure the final answer. If the student was correct, he/she would play a game where the cartoon character's dog would sniff out and eat asterisks found in a maze. If the student was wrong, however, he/she was prompted to try solving the problem again. When the computer session was over, the computer would figure a grade of how well the student did on the math problems. Several students were excited enough to announce across the classroom that they had earned a 100% on the computer activity.

Meanwhile, the teacher had the group at the table review the multiplication of three digit numbers first (Johnson and Ross, 1989). She then went on to teaching the students how to multiply fractions. The teacher used the chalkboard to illustrate how the problems were solved properly and asked the students questions. The teacher then had the children in groups of two or three go to the blackboard and solve problems she

assigned them orally. She observed the children as they solved the problems, saying something only when they needed feedback or instructions.

The math teacher's method of dividing the class into two groups based on ability allowed her to use the computer effectively because she was able to decrease the student/teacher ratio (Johnson and Ross, 1989). The teacher alternated the groups allowing the students to receive equal amounts of active instruction and computer drills. The "drill and practice" computer program provided personalized tutoring. The teacher's method of using easily available computer technology helped independent tutoring occur naturally, resulting from the consistent flow of instruction from the teacher and computers in the classroom.

Gierl and Bisanz (1995) discovered that children experience more math test anxiety as they grow older which in turn is related to general test anxiety. Richardson and Suinn (as cited in Gierl and Bisanz, 1995) described anxiety as "feelings of tension that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations." Gierl and Bisanz (1995) also defined math test anxiety as "feelings of nervousness associated with past, present, and future mathematical testing situations."

The researcher is currently unaware of any specific methods for testing anxiety during timed math tests; however, there are several options from which to choose in order to assess general math test anxiety. The *Mathematics Anxiety Survey (MAXS)* asked students to indicate how nervous they were by circling one of five choices from "not at all nervous" to "very, very nervous" which included pictures at both ends of the scale to avoid confusion (Gierl and Bisanz, 1995). The *Mathematics Anxiety Rating Scale*

(*MARS*) includes 98 situations in which students describe how anxious they would feel on a scale from one to five with one being "not at all," (Suinn as cited in Schneider and Nevid, 1993). The *Affect Adjective Checklist (AACL)* contained 21 adjectives from which students were to select to describe the feelings they were experiencing at the time (Zuckermann as cited by Schneider and Nevid, 1995). The adjectives included eleven ways to express anxiety and ten ways to express the lack of anxiety. The *Physiological Measurement* measures anxiety through the change in heart rate (Dew et al. research as cited by Schneider and Nevid, 1995). Tankersley (1993) reasons that many children develop math anxiety around the time they are in fourth grade because teachers often change from teaching concrete concepts to more abstract math at that level. The Cordova school in Phoenix, Arizona bought a computer system in order to help the students improve their math skills and to provide teachers with more time for their students by using the computer for grading and other necessary paper work. The Cordova teachers were able to divide their classes in the math lab allowing some students to use the computers for enrichment work and drill-and practice exercises when needed. Tankersley claims that the enthusiasm for math that the Cordova students feel is apparent to all who meet them and "their test scores reflect it" (p. 13).

Studies have shown that in elementary school girls have slightly better computational skills than boys do (Hyde, Fennema, and Lamon as cited by Casey et al., 1997). Meanwhile, Wizfield and Eccles (as cited in Casey et al., 1997) found that children's math grade achievement is strongly related to how well or poorly they expect to perform.

There are many studies on math tests, test anxiety, math anxiety, and technology. The participants in these studies range from preschool age to the elderly; however, they do not combine all four categories, as well as the time aspect. This study may be based primarily on grade school children, but it can also be applied to much higher levels of education and even other subjects. This particular study can help students, parents, teachers, education based companies, computer companies, and curriculum and budget decision-makers.

CHAPTER III Methodology

The researcher administered a pencil and paper test as well as a computer test involving a time limit and a series of basic math facts. The researcher conducted all research at a small elementary school in the Midwest using two second grade classrooms in which a total of 14 children participated. In this research, the researcher compared the test results, blood pressures, and pulses. The researcher also administered a survey to the students and conducted interviews with a few randomly chosen students. The comparisons of the numerical data, and the analysis of the survey information, the observations, and the interview responses are important because they allowed the researcher to discover which test, if either, led to the least amount of anxiety the students experienced, and which test was best received by the students.

The pencil and paper version of the test consisted of 100 basic addition problems on one page with answers ranging from 0 to 18 that the researcher adapted from a test created by Saxon Publishers. The students' goal was to complete the paper test within one minute. The researcher told the students when to start and when to stop when the one minute had elapsed. The computer version of the test was also created by Saxon Publishers and is available on the Internet. The timed math test site can be found at the address of www.saxonpublishers.com/activities/basic_fact_sheets/. The computer version of the test included 50 basic addition problems with answers ranging from 0 to 18, a timer that began when the student touched the first key and ended when the student hit the tab button after the last problem, and an automatic grader. The computer allows the teacher or student to choose the time limit goal; in this case the goal was set at a 30 second time limit in proportion with the paper and pencil test. The computer does,

however, allow a student to complete the test even after the time limit is up. After a student is finished, he or she clicks the "submit" button on the screen to receive his or her results. The results include how many problems the student answered correctly, what problems the student missed, how long the test lasted, and how many problems the student got correct in the "goal" time limit.

The paper and pencil test score was compared with the computer test score. After each test, the score was recorded on a chart in order to make clear, easy comparisons. The version of the test with the highest average test score for each student is the one that was considered to be the best received by the student and the one causing the least anxiety. The differences in test scores, blood pressures, and pulses were examined to see if they correlated with each other on anxiety indications.

Before each test, four volunteers from a small, nearby university and the researcher took the blood pressures and pulses of the students while they were at rest focusing on an activity, such as coloring pictures or the teacher talking. The volunteers and the researcher took the blood pressures and pulses again right before the students took the tests, and right after the tests. The blood pressures and pulses were recorded on charts each time for quick, easy comparisons. The volunteers and the researcher divided the class equally, took the blood pressures and pulses of the same students each time, and used the same digital blood pressure cuffs through the whole process. The understanding was that each student had a different base blood pressure and pulse along with different increases when anxiety is present; therefore, each student's blood pressures and pulses were compared only with their own readings for the two types of tests. Also understood was that students may feel anxiety caused by sources other than the test which was why a

base blood pressure and pulse was taken each time a test was administered. The assumption was that the lower the differences in blood pressures and pulses right before the test from the rest readings and the differences in blood pressures and pulses right after the test from the rest readings the less anxiety the student experienced.

Finally, the researcher administered a survey and conducted some interviews with randomly chosen students in order to specify likes and dislikes, excitement and anxiety, and tests and equipment that affected the students the most. The researcher gave each student a survey to complete.

CHAPTER IV

Results

This researcher found that some students exhibited signs of anxiety for both the computer and pencil and paper test, some exhibited signs of anxiety for only one of the two tests, and some exhibited no signs of anxiety for either test. The results of this study varied from student to student as to how well he/she performed on the computer test and the paper-and-pencil test, his/her blood pressure readings and his/her pulse readings. Each student's test scores, blood pressure readings, and pulse readings were compared only with his/her own. Overall, the students had better scores on the paper and pencil test as compared to the computer test. Surveys of all fourteen students were also conducted with varying responses to such questions as to how each student felt about each test and the different instruments used in the study. Finally, five randomly chosen students were interviewed about their individual performances and feelings about participating in this research.

Test Scores

All of the students scored higher percentages on the paper and pencil test than on the computer test. The paper and pencil test consisted of 100 basic addition problems with answers ranging from 0 to 18 that were to be completed in 60 seconds. The computer test consisted of 50 of the same type of problems to be completed in 30 seconds. In order to compare the percentages of questions answered correctly, the researcher computed the percentage of the paper and pencil test and then divided it by two in order to discover the percentage earned in approximately the first 30 seconds, and then the researcher computed the percentage of correct answers in 30 seconds on the

computer test. Table 1 in the appendix contains all 14 paper and pencil test scores, computer test scores, differences in percentage points between the two tests, and the percentages of improvement with the exceptions of two where the improvement from 0 could not be figured. The paper and pencil test scores ranged from 2.5% to 18.5% while the computer test scores ranged from 0% to 12%. The smallest increase in percentage points was one while the largest increase in percentage points was 12.5. The percentages of improvement ranged from 12.5% to 300% not including the improvement of the two students who earned 0% on their computer tests. The average increase in percentage points was four, and the average percentage of improvement was 72.05%. Graph 1 in the appendix illustrates the consistent increase in paper and pencil test scores as compared to the computer test scores. The higher paper and pencil test scores when compared to the computer test scores lend support to the theory that the students felt less anxiety when taking the paper and pencil test and that it was the test better received by the students.

Blood pressures

Each student's blood pressure was taken while he/she was sitting, right before he/she took each of the two tests, while he/she was waiting to be told to begin with the test placed in front of him/her, and right after each student took each of the two tests. Table-2 gives each student's resting blood pressure as well as the before and after blood pressures for the computer and paper and pencil activities. Eight students' blood pressure readings decreased from the rest measure to the measure taken right before beginning the computer test, and nine students' blood pressure readings decreased from the rest measure to the measure taken right before beginning the paper and pencil test as seen in Table 3. However, only six students experienced lower blood pressure readings after the

computer test when compared to the rest readings as well as, only six students experiencing decreases in their blood pressure readings after the paper and pencil test. Five students experienced lower blood pressure readings from the rest reading for both the before and after of both tests. Only two students experienced higher blood pressure readings for both the before and after parts of both tests. The highest blood pressure reading was 139/87 and the lowest was 62/33. The average resting blood pressure was 100.57/65; the average blood pressure before the computer test was 97.21/61.36; the average blood pressure after the computer test was 101.43/64.79; the average blood pressure before the paper and pencil test was 91.93/57.43; the average blood pressure after the paper and pencil test was 96.36/60.29. The average change in blood pressure from rest to before the computer test was $-3.36/-3.5$; the average change in blood pressure from rest to after the computer test was $.86/-.21$; the average change in blood pressure from rest to before the paper and pencil test was $-8.64/-7.57$; and finally, the average change in blood pressure from rest to after the paper and pencil test was $-4.21/-4.71$. Since most of the blood pressures decreased from the resting blood pressure according to the average changes in blood pressures, one theory is that the blood pressure cuff was unfamiliar in the classroom setting, the researcher and university volunteers doing the testing were new to the students, and the anticipation of the unknown because they did not know exactly what activities to expect or what was expected of them. Most of the students then settled down as they became used to the blood pressure machines, the volunteers, and were able to see the tests and understood what was expected of them. However, there were nine students that experienced elevations in blood pressure as they participated in the activities which lends credence to the theory that they became nervous

or excited about the test or tests. Nine students experienced an increase in blood pressure on the computer test, and eight students experienced an increase in blood pressure on the paper and pencil test.

Pulses

The pulse of each student was taken at rest while he/she was sitting, right before he/she took each of the two tests, while he/she was waiting to be told to begin with the test placed in front of him/her, and right after each student took each of the two tests. Table 4 in the appendix shows each student's five pulse readings while Graph 2 gives the comparison of each child's pulses visually side-by-side. Table 5 in the appendix gives the amount of increase or decrease if any between the rest pulse and the before and after of both the computer and pencil and paper activities. Six students experienced a decrease in pulse from rest to before the computer test, and seven students experienced a decrease in pulse from rest to before the paper and pencil test. However, only five students experienced a decrease in pulse after the computer test, and seven students experienced a decrease in pulse after the paper and pencil test. Two students experienced a decrease in pulse on both the before and after of both tests, and three students experienced an increase on both the before and after of both tests which supports the theory that they were experiencing anxiety and/or excitement on both tests. The pulse readings ranged from 56 to 116. The average resting pulse was 85.2; the average pulse before the computer test was 86.71; the average pulse after the computer test was 86.57; the average pulse before the paper and pencil test was 82.64; and the average pulse after the paper and pencil test was 85.43. The most significant change in the pulses according to the averages of the changes between rest and the before and after of each test is a decrease of

-2.57 from rest to before the paper and pencil test which lends support to the theory that most of the students were most relaxed right before the paper and pencil test with seven students decreasing, two students being the same, and only five students with any increases at all. Overall, the paper and pencil test had the least amount of average increase in the pulses with the averages being 1.5 between the rest and before computer, 1.36 between the rest and after computer, -2.57 between the rest and before paper and pencil, and .21 between the rest and after paper and pencil. Eleven of the students experienced an increase in their pulse at one time or another with ten students experiencing increases before, after, or both on the computer, and only six students experiencing increases before, after, or both on the paper and pencil test. According to Graph 2, most students had their own pattern of increases and decreases in their pulses; student eight showed very little variation in his/her pulse for the rest and both tests giving the impression that he/she was fairly comfortable the whole time, whereas, students three and four seem to be the only ones with similar increases and decreases in pulses.

Survey

The survey was given to all 14 students after they completed both activities in order for them to tell the researcher how they felt about the activity as a whole, individual parts of the activities, the instruments used, and their likes and dislikes about the activities and related subjects, such as math itself. The exact questions and the percent of the students who responded each answer can be found in the appendix. The computer test was chosen as the activity best liked by the students with a response of 64.3%. A majority of the students at 57.1% claimed they were not nervous when they participated in the computer activity, while 64.3% claimed they were not nervous during the paper

and pencil activity. When asked which activity they were most nervous about, there was a tie at 35.7% for both the computer and paper and pencil activities. According to the survey, 85.7% of the students liked the computer activity and 78.6% liked the paper and pencil activity. Most of the students at 78.6% claimed the computer did not make them nervous nor did taking their blood pressures and pulses at 85.7%. Unanimously all of the students liked computers, and a majority at 92.9% liked math. When asked if they liked timed math tests, 78.6 responded positively with a yes. Meanwhile, 64.3% of the students claimed they were excited about the computer activity, but 57.1% claimed they were not excited about the paper and pencil activity. Overall, most of the students claimed they would practice the activities in the future with 71.4% for the computer and 92.9% for the paper and pencil. According to the survey results, the activities were well received by most of the students.

Interviews

The researcher interviewed five randomly chosen students after they completed both activities and their surveys. The exact interview questions can be found in the appendix. When asked which activity they preferred, if either, three claimed they liked both activities the same and the following comment was made: "except the computer was longer, and my hands got tired." A possible explanation for the previous comment is the students were allowed to finish their computer activity past the time limit and the computer recorded the 30 second score and the finished score. One student liked the computer activity better because "I like to type, and it's real fun on the computer." Another student preferred the paper and pencil activity "because it's fun doing timed tests. I do them everyday." Four of the five students felt they did better on the paper and

pencil test because “just fun and do everyday,” “I didn’t get so tired because the computer messed up and it freaked me out,” “it was fun, and I liked it a lot,” and “I don’t think I did something right on the computer, and I know I don’t miss much on the paper and pencil.” One student felt he/she did better on the computer test because “you get more time to do it and make sure it is right” (the students were told they only had 30 seconds and to work as quickly as possible). Varying responses were made when asked how often they practice timed math tests of any kind. Three students responded along the lines of everyday or a few times a week at school on the paper and pencil test. One student answered, “not very long since kindergarten.” Another student admitted he/she did practice a little at home because his/her mother made him/her do it. Four of the students said the computer was good or fun when asked what they thought of it, and one student said, “not very fun.” When asked how they felt about the blood pressure machine, several student said it felt funny (a good funny), one claimed it kind of tickled, another claimed it was fine. When asked on a previous question what they felt they had done best on one student answered the blood pressure before the researcher clarified that he/she was to choose between the computer and paper and pencil activity. All the students appeared to be excited about getting their blood pressures and pulses taken when they would say, “Can I go now? Is it my turn? What was your number? My number was... Can I push the button?” When asked if anything made them nervous, three claimed nothing did, but one claimed everything but the paper and pencil made him/her nervous because he/she was in a hurry. Another claimed the computer activity made him/her nervous because “I didn’t know if I would get all the answers right or not.” The familiarity with the paper and pencil test from taking similar ones in their classroom

seemed to improve their confidence about their performance when compared to the unfamiliar computer activity. Overall though, the students seemed to enjoy the computer because it was the computer and they could press keys and such.

The results of the test scores, the blood pressure readings, the pulse readings, the surveys, and the interviews shed light on how many second grade students feel about math, computers, timed testing, and new activities in the classrooms. According to the test scores, all 14 students performed better on the paper and pencil test giving support to the theory that the students are more comfortable with the paper and pencil test and therefore experience less anxiety. While there is not a great deal of variation by average in the anxiety students feel toward the computer and paper and pencil tests according to blood pressures and pulses, the paper and pencil test had a majority of the lower readings and a minority of the higher readings when compared to the computer test. According to the survey 42.9% felt nervous about the computer activity, while 35.7% felt nervous about the paper and pencil activity, however, when asked which of the two made them most nervous the results were a tie with the students responding to the computer at 37.5% and the paper and pencil at 37.5%. According to the survey the 64.3% of the students preferred the computer activity to the paper and pencil, and according to the interview three of the five students liked both activities the same while another preferred the computer and a fifth preferred the paper and pencil activity. Finally, 71.4% of the students claimed they will practice the computer program more in the future, however, even more at 92.9% claim they will practice the paper and pencil more in the future, and during the interviews several claimed they will be doing the paper and pencil test several times a week in their classroom in the future. So, overall the students enjoy the

computers and would like to be able to spend more time on them, however, they feel more comfortable with the paper and pencil test because they are familiar with it and practice it regularly.

CHAPTER V

Discussion

This research gives support to the theory that the paper and pencil test caused less anxiety than the computer test; however, given different circumstances as the researcher will explain later the results could switch to the same amount of anxiety experienced when taking either test or to the computer test causing less anxiety than the paper and pencil test. Using the blood pressure and pulse readings, there was only a small amount of difference in the levels of anxiety measured while the students were taking their tests with only one or two more students experiencing increased readings on the computer test when compared to the number of students with increased readings on the paper and pencil test. The test scores, on the other hand, revealed that all fourteen students did better on the paper and pencil test by at least one percentage point. The surveys also supported the readings and test scores in the theory that the paper and pencil test caused less anxiety. Finally, the interviews confirmed that the students were more comfortable with the paper and pencil test.

The findings in this research are supported by Lee, Llabre et al., Russon, Josefowitz, Edmonds, and Tardif (as cited in Dimock and Cormier, 1991) who claim that research indicates that people with regular computer experience normally feel less anxiety than people without computer experience when the computers are made accessible to them. The two classes in this research each had only one computer, and the students had limited time in the computer lab as compared to doing paper and pencil activities on a regular basis in the classroom. More to the point in this case, is that the students had been exposed to timed paper and pencil math tests similar to the one in this research and felt an immediate relief when they discovered they were not going to have

to do something totally new to them; however, the students had not been exposed to a computer program similar to the one used in this research and felt anxiety about being able to perform as well on the computer test as the paper and pencil, being able to push the correct keys, and just use the computer correctly. In addition, Cormier and Dimock (1991) did some research performing two experiments that revealed that the scores of the original pencil and paper test were better than the scores on the similar computer format. Research has also shown that children tend to enjoy computers, and they tend to excel and increase math scores when exposed to computer math programs regularly especially when they know the reward of finishing an assignment or test is the chance to play a computer game or when the assignment itself is a game (Yeloushan, 1986; Fitch and Sims and S. W. Haugland as cited in Din and Caleo, 2000; Lee, Llabre et al., Russon, Josefowitz, Edmonds, and Tardif, Johnson and White, Lee, Moreno, and Sympson as cited in Dimock and Cormier, 1991; Johnson and Ross, 1989; Tankersley, 1993).

Two of the main limitations on this research were that the students were more familiar with one test than the other and the researcher had limited time in each of the classrooms. In future research, the students should be given a pretest of each test so that familiarity is not a problem and so that the students will know what to expect so that they are not going through the whole test wondering if they are doing everything correctly on this test when they know exactly what to do on the other because they have completed it before. The pretest is important because their comfort during the computer test was a topic that the students brought up in the interviews since it was unfamiliar to them and the paper and pencil test was a regular part of their classroom assignments. The pretest could make a significant difference in the test scores, blood pressure readings, and pulse

readings, a small difference, or no difference at all, but it would remedy one of the problems the students brought up in this research. The other limitation of limited time in the classroom may have also affected the test scores and blood pressure and pulse readings. The tests went over from class time into the students' lunch time, and a few were worried that they would not get to eat lunch or go to recess because most of the other students got to leave while they had to stay and finish the tests. The students were reassured that they would be allowed to eat lunch, but they were still anxious about it. In future research, the students should be reassured ahead of time by the teacher and the researchers that they will be allowed to go to lunch, recess, the restroom, the water fountain, and any other place or activity they feel is necessary in their elementary school lives. Finally, in future research, the blood pressure should only be taken at rest and at the end of all the testing with the pulse being taken at same intervals as in this research because the blood pressures being taken with little time in between each reading affects the pressure in the artery used and therefore can give inaccurate readings; whereas, the pulse readings remain unaffected by this. Other studies that can be performed stemming from this research include comparing anxiety levels between school grade levels, between males and females, between students from different economic levels, and between students of different races. The differences in anxiety levels between timed and not timed math tests can also be studied. Gifted students, average students, and below average students can be tested and their anxiety levels on each test compared. Another possible study would be to see which test the students complete and make a 100% on first, or using repetition how fast can students become at either or both the paper and

pencil test and the computer test and how many tries does it take for them to reach these levels.

This research project also led to some ideas for some regular classroom activities and lessons. One idea is to bring one or two digital blood pressure cuffs into the classroom for some math and science lessons. The digital blood pressure machines give the blood pressure as a fraction and the pulse as a whole number. The students could take their own individual readings and write them down then they could compare their readings with the other students to decide if their readings are greater than, less than, or equal to the other students' individual readings. The students could also use the numbers for addition and subtraction to see the combined readings and the differences in the readings. The students could also take the average of the whole class's pulses. Pulses could also be recorded and graphed over a period of time. In addition, the teachers could use the blood pressure readings to give an assignment on adding or subtracting fractions. The teachers could also use the blood pressure machine in their science lessons to teach students about the circulatory body system, how blood pressure and pulse readings are taken, what they mean, what are the highs and lows for each body size and age, and of course just how to get healthy and remain healthy. The students in this study really liked the blood pressure machine and were excited about doing something new, so the researcher believes that this excitement can be carried on into several different lessons like those listed above. Something else the teachers could do is have basic math fact races every once in a while with a small prize to be won by the person to make a 100% the fastest. Another thing teachers can try is to have a chart where the students put a stamp or sticker by their names each time they complete their test faster than they have

done previously; this allows each student to compete against him/herself, set goals, and try to achieve goals which can be important life lessons.

This study shows that familiarity plays a part in the level of anxiety a person may experience. The research of others as well as this research supports the theory that the more familiar people are with something the more comfortable they are and the less anxiety they experience. According to the survey in this research all of the students like computers, but were not necessarily comfortable with taking the new test. At the second grade level, most of the students claim to like math, as well. Finally, few students felt any anxiety towards the blood pressure machine. Overall, the computer test seemed to cause a little bit more anxiety than the paper and pencil test, and both tests were well received by the students.

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9	6	3	5	8	2	0	7	4	1
<u>+9</u>	<u>+7</u>	<u>+1</u>	<u>+4</u>	<u>+5</u>	<u>+7</u>	<u>+3</u>	<u>+8</u>	<u>+4</u>	<u>+2</u>

3	5	6	2	4	9	1	7	8	2
<u>+4</u>	<u>+9</u>	<u>+6</u>	<u>+3</u>	<u>+9</u>	<u>+7</u>	<u>+8</u>	<u>+7</u>	<u>+0</u>	<u>+5</u>

6	4	3	9	1	7	2	5	8	6
<u>+4</u>	<u>+8</u>	<u>+9</u>	<u>+6</u>	<u>+7</u>	<u>+4</u>	<u>+6</u>	<u>+5</u>	<u>+6</u>	<u>+3</u>

4	7	2	3	6	5	9	8	1	5
<u>+9</u>	<u>+2</u>	<u>+0</u>	<u>+3</u>	<u>+4</u>	<u>+6</u>	<u>+8</u>	<u>+4</u>	<u>+5</u>	<u>+9</u>

7	9	1	2	4	8	3	6	1	0
<u>+1</u>	<u>+4</u>	<u>+1</u>	<u>+3</u>	<u>+2</u>	<u>+6</u>	<u>+9</u>	<u>+6</u>	<u>+3</u>	<u>+4</u>

5	4	3	2	1	9	8	7	6	5
<u>+9</u>	<u>+1</u>	<u>+7</u>	<u>+9</u>	<u>+8</u>	<u>+1</u>	<u>+7</u>	<u>+6</u>	<u>+4</u>	<u>+3</u>

3	2	4	9	7	6	5	8	5	9
<u>+2</u>	<u>+8</u>	<u>+7</u>	<u>+5</u>	<u>+9</u>	<u>+6</u>	<u>+4</u>	<u>+3</u>	<u>+5</u>	<u>+8</u>

6	3	2	4	5	9	1	7	8	6
<u>+1</u>	<u>+4</u>	<u>+6</u>	<u>+4</u>	<u>+7</u>	<u>+3</u>	<u>+6</u>	<u>+7</u>	<u>+0</u>	<u>+5</u>

1	0	2	3	5	4	6	9	8	7
<u>+1</u>	<u>+0</u>	<u>+5</u>	<u>+7</u>	<u>+9</u>	<u>+3</u>	<u>+6</u>	<u>+0</u>	<u>+7</u>	<u>+1</u>

Saxon Publishers' Basic Facts Sheets

Student Name:
(optional)

Choose Type(s) of Problems to Solve: ☒ Addition
☐ Subtraction
☐ Multiplication
☐ Division

Choose Largest Number to Use: 9 

Choose Number of Problems to Solve: 50 

Choose a Timing Option: 30 seconds 

Begin

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A: <input checked="" type="checkbox"/> $\begin{array}{r} 8 \\ + 3 \\ \hline \end{array}$	A: <input checked="" type="checkbox"/> $\begin{array}{r} 2 \\ + 7 \\ \hline \end{array}$	A: <input checked="" type="checkbox"/> $\begin{array}{r} 4 \\ + 0 \\ \hline \end{array}$	A: <input checked="" type="checkbox"/> $\begin{array}{r} 6 \\ + 9 \\ \hline \end{array}$	A: <input checked="" type="checkbox"/> $\begin{array}{r} 8 \\ + 3 \\ \hline \end{array}$
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A: <input checked="" type="checkbox"/> 8 + 4	A: <input checked="" type="checkbox"/> 1 + 1	A: <input checked="" type="checkbox"/> 3 + 3	A: <input checked="" type="checkbox"/> 9 + 4	A: <input checked="" type="checkbox"/> 4 + 0
T: <input checked="" type="checkbox"/> 12	T: <input checked="" type="checkbox"/> 2	T: <input checked="" type="checkbox"/> 6	T: <input checked="" type="checkbox"/> 13	T: <input checked="" type="checkbox"/> 4

Legend

Correct Answers

A: ☒

Answered Within Time

T: ☒

Incorrect Answers

A: ☒

Answered Past Time

T: ☒

Results Summary

Your overall percentage is: 92%

You answered 46 problems correctly.

You answered 4 problems incorrectly.

Target time: 30 seconds.

Time elapsed: 1 minute 3 seconds.

Number correct in 30 seconds: 20

Try Again With These Settings

Start Over

Quit

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Table 1

TEST SCORES				
Student	Computer Score %	Paper and Pencil Score %	Differences (in points)	% of Improvement in the Paper Test from the Computer Test
1	2	8	6	300
2	12	15	3	25
3	0	11.5	11.5	N/A
4	0	2.5	2.5	N/A
5	8	9	1	12.5
6	8	9	1	12.5
7	8	9.5	1.5	18.75
8	6	18.5	12.5	208.33
9	8	13.5	5.5	68.75
10	8	12.5	4.5	56.25
11	2	4	2	100
12	8	9	1	12.5
13	8	9	1	12.5
14	8	11	3	37.5

Test Scores
Graph 1

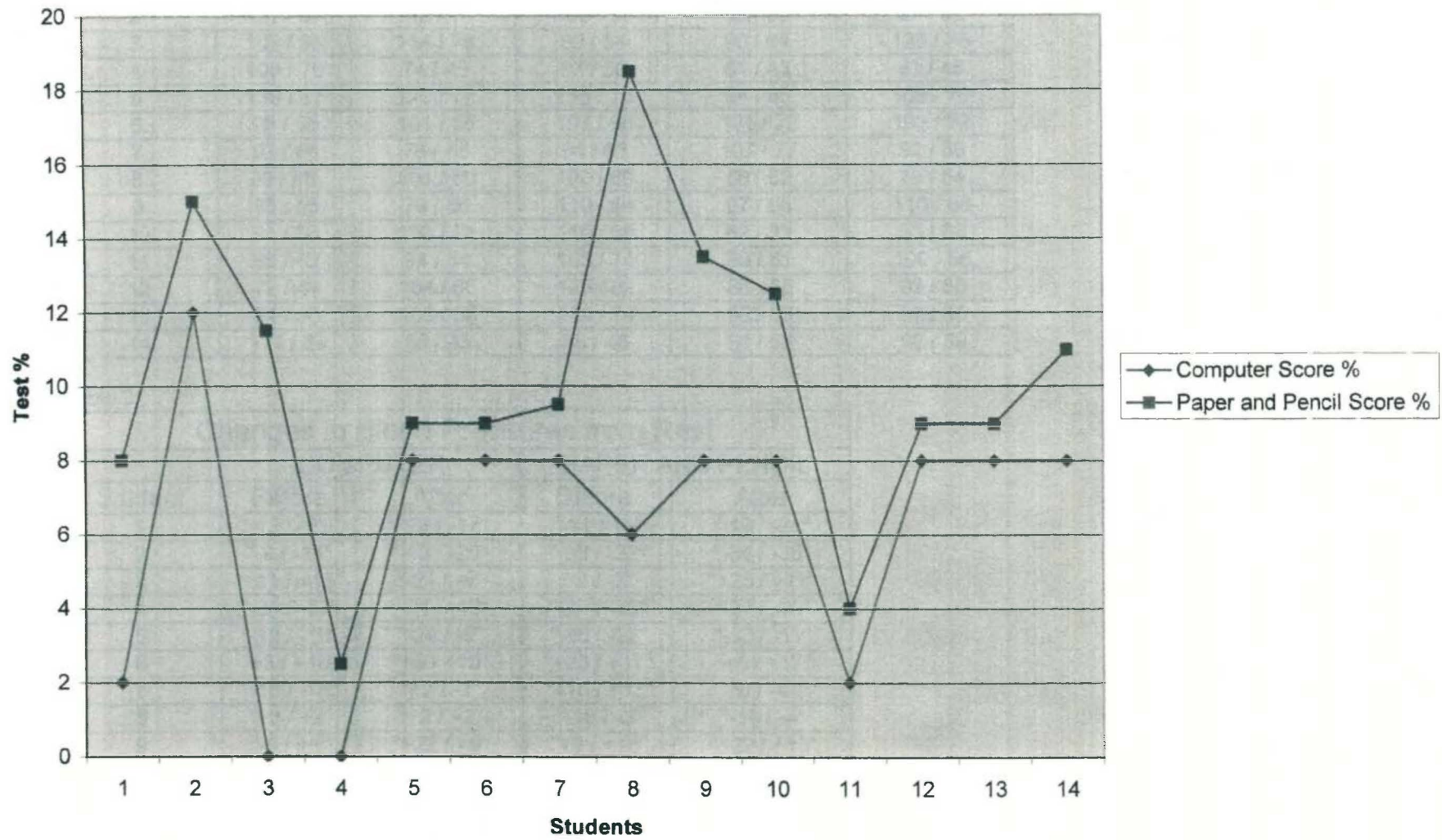


Table 2

BLOOD PRESSURES					
		COMPUTER		PAPER AND PENCIL	
Student	Rest	Before	After	Before	After
1	108 / 74	95 / 51	86 / 57	97 / 61	89 / 53
2	121 / 87	112 / 73	108 / 67	88 / 55	87 / 52
3	103 / 63	114 / 78	82 / 54	96 / 61	128 / 75
4	108 / 78	74 / 45	87 / 59	81 / 43	81 / 48
5	139 / 87	120 / 77	115 / 78	94 / 65	109 / 76
6	98 / 55	101 / 65	103 / 65	121 / 72	103 / 72
7	92 / 64	76 / 48	94 / 63	107 / 77	92 / 60
8	98 / 58	101 / 60	100 / 60	80 / 52	79 / 54
9	88 / 55	79 / 56	110 / 64	97 / 68	110 / 68
10	91 / 58	100 / 71	110 / 65	62 / 33	93 / 58
11	95 / 62	94 / 54	103 / 74	89 / 51	100 / 56
12	72 / 44	104 / 68	123 / 82	86 / 55	93 / 58
13	84 / 56	105 / 68	114 / 74	95 / 55	87 / 55
14	111 / 69	86 / 45	85 / 45	94 / 56	98 / 59

Table 3

Changes in Blood Pressures from Rest				
	COMPUTER		PAPER AND PENCIL	
Student	Before	After	Before	After
1	"-13 / -21"	"-22 / -17"	"-11 / -13"	"-19 / -21"
2	"-9 / -14"	"-13 / -20"	"-33 / -32"	"-34 / -35"
3	" +11 / +15"	"-21 / -9"	"-7 / -2"	" +25 / +12"
4	"-34 / -33"	"-21 / -19"	"-27 / -35"	"-27 / -30"
5	"-19 / -10"	"-24 / -9"	"-45 / -22"	"-30 / -11"
6	" +3 / +10"	" +5 / +10"	" +23 / +17"	" +5 / +17"
7	"-16 / -16"	" +2 / -1"	" +15 / +13"	"0 / -4"
8	" +3 / +2"	" +2 / +2"	"-18 / -6"	"-19 / -4"
9	"-9 / +1"	" +22 / +9"	" +9 / +13"	" +22 / +13"
10	" +9 / +13"	" +19 / +7"	"-29 / -25"	" +2 / 0"
11	"-1 / -8"	" +8 / +12"	"-6 / -11"	" +5 / -6"
12	" +32 / +24"	" +51 / +38"	" +14 / +11"	" +21 / +14"
13	" +21 / +12"	" +30 / +18"	" +11 / -1"	" +3 / -1"
14	"-25 / -24"	"-26 / -24"	"-17 / -13"	"-13 / -10"

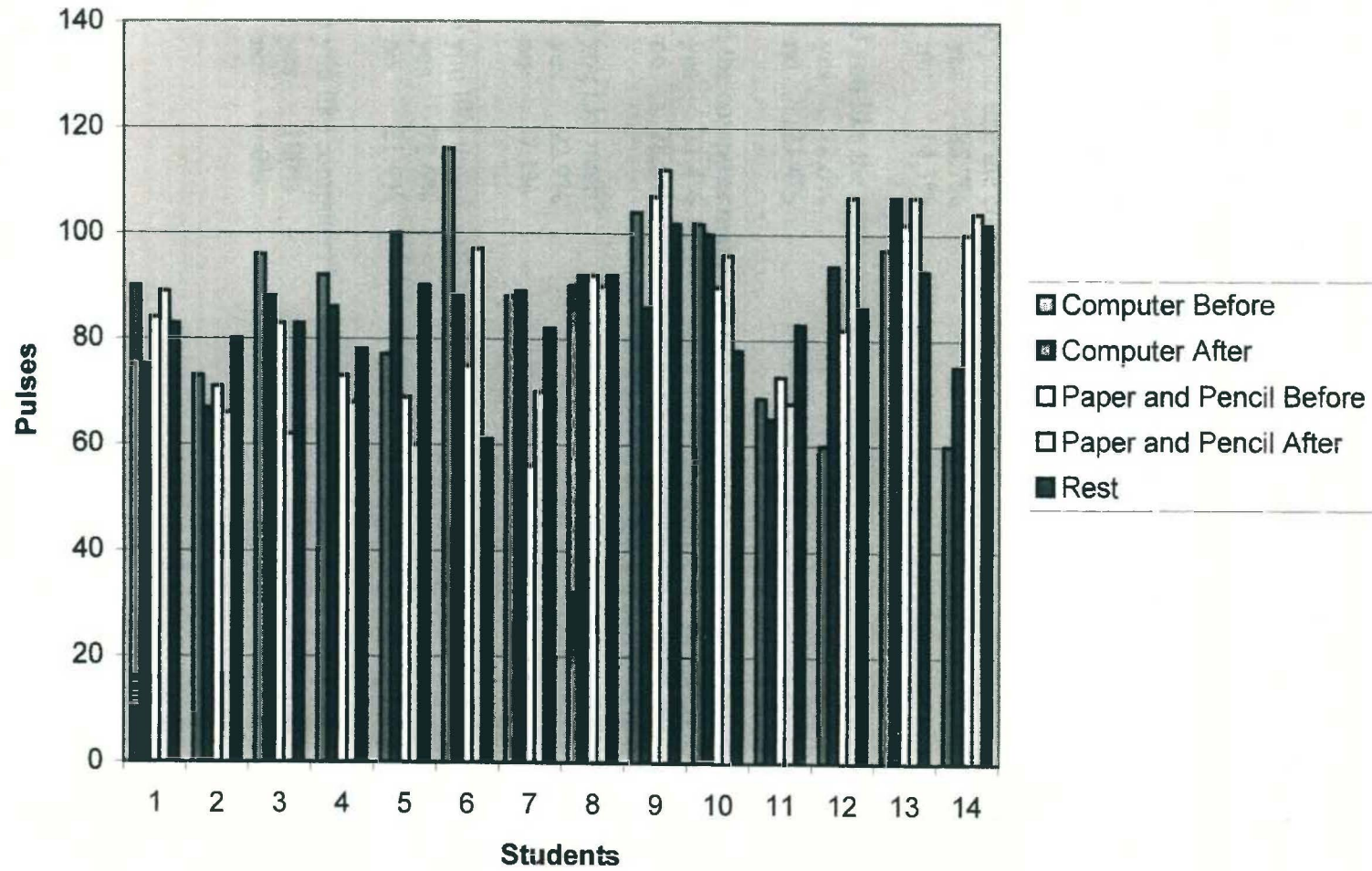
Table 4

PULSES					
		Computer		Paper and Pencil	
Student	Rest	Before	After	Before	After
1	83	90	75	84	89
2	80	73	67	71	66
3	83	96	88	83	62
4	78	92	86	73	68
5	90	77	100	69	60
6	61	116	88	75	97
7	82	88	89	56	70
8	92	90	92	92	90
9	102	104	86	107	112
10	78	102	100	90	96
11	83	69	65	73	68
12	86	60	94	82	107
13	93	97	107	102	107
14	102	60	75	100	104

Table 5

Changes in Pulses from Rest				
	Computer		Paper and Pencil	
Student	Before	After	Before	After
1	7	-8	1	6
2	-7	-13	-9	-14
3	13	5	0	-21
4	14	8	-5	-10
5	-13	10	-21	-30
6	55	27	14	36
7	6	7	-26	-12
8	-2	0	0	-2
9	2	-16	5	10
10	24	22	12	18
11	-14	-18	-10	-15
12	-26	8	-4	21
13	4	14	9	14
14	-42	-27	-2	2

Students' Pulses
Graph 2



Student Survey

1. Which test did you like best?
 - a. pencil and paper 14.3%
 - b. computer 64.3%
 - c. neither 21.4%
2. Did you feel nervous when you participated in the computer activity?
 - a. yes 42.9%
 - b. no 57.1%
3. Did you feel nervous when you participated in the pencil and paper activity?
 - a. yes 35.7%
 - b. no 64.3%
4. Which activity did you feel most nervous about when you participated in it?
 - a. pencil and paper 35.7%
 - b. computer 35.7%
 - c. neither 28.6%
5. Did you like the computer activity?
 - a. yes 85.7%
 - b. no 14.3%
6. Did you like the paper and pencil activity?
 - a. yes 78.6%
 - b. no 21.4%
7. Did the computer make you nervous?
 - a. yes 21.4%
 - b. no 78.6%
8. Do you like math?
 - a. yes 92.9%
 - b. no 7.1%
9. Do you like timed math tests?
 - a. yes 78.6%
 - b. no 21.4%
10. Do you like computers?
 - a. yes 100%
 - b. no 0%

11. Did taking your blood pressure and pulse make you nervous?

- a. yes 14.3%
- b. no 85.7%

12. Did you get excited about the computer activity?

- a. yes 64.3%
- b. no 35.7%

13. Did you get excited about the paper and pencil activity?

- a. yes 42.9%
- b. no 57.1%

14. Will you practice the computer activity in the future?

- a. yes 71.4%
- b. no 28.6%

15. Will you practice the paper and pencil activity in the future?

- a. yes 92.9%
- b. no 7.1%

Student Interview

1. Do you prefer one activity to the other and why?
2. Which test (paper and pencil or computer) do you think you did best on, and why do you think you did better on it?
3. How often do you practice and for how long?
4. What did you think of the computer?
5. How did you feel about the blood pressure cuff?
6. Did anything make you nervous (computer activity and/or paper and pencil activity and/or blood pressure cuff) and if so why?